

DESIGN OF A SANITARY SEWER SYSTEM
AND
DISPOSAL PLANT FOR CRETE, ILLINOIS

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ARMOUR INSTITUTE OF TECHNOLOGY
1917

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Design of a sanitary sewer
system and disposal plant

DESIGN OF A SANITARY SEWER SYSTEM AND DISPOSAL PLANT FOR THE VILLAGE OF CRETE, ILL.

A THESIS

PRESENTED BY

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HYMEN F. WALDER

TO THE

PRESIDENT AND FACULTY

OF

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IN

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MAY 31, 1917

APPROVED:


Professor of Civil Engineering

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A C K N O W L E D G E M E N T

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Acknowledgement is given Mrs. Beveridge for the assistance in their reference work.

The authors also desire to acknowledge the valuable assistance of Mr. D. O. Seliger in the first day of their Field work, and the courtesy extended to them by Mr. Arthur Lucke, Clerk of The Village of Crete.

B I B L I O G R A P H Y

American Sewerage Practice Vol. 1 & 3.
Metcalf and Eddy---1916 Ed.

Sewage---Folwell---1916 Ed.

Sewage Purification and Disposal.
Cosgrove---1909 Ed.

Imhoff Tanks.
Pamphlet by Pacific Flush Tank Co.

Chapman Valve Mfg. Co. Cat. No. 30.

I N T R O D U C T I O N

The authors in looking for a Thesis subject which not only would require original investigation, but which would also be of a practical value, directed their efforts upon the design of a sewerage system and disposal plant for some village in the vicinity of Chicago. The initial step was the choice of a village which lacked a sewer system, and Plainfield was selected.

So a trip was made to Joliet, the county seat, and the records and plats of Plainfield were looked up. On finding that Plainfield had already installed a sewerage system since 1914, the authors turned their attention to the villages of Frankfurt, Crete, and Beecher. On the same day an inspection trip was made to Frankfurt and Crete, and the latter was selected for the field of study and operation.

A plat of the village was traced from the plat on the wall at the Village Fire Dept., and from this plat, with a few corrections and alterations, the authors ran their levels, for the pipe layout, and profiles, and the "stadia" for the location of the disposal plant.

Every effort was made by the authors to design the system as efficiently and economically as the local conditions of the village would permit.

T H E V I L L A G E O F C R E T E

The Village of Crete, is located in Will County, Illinois. It is about thirty miles from Chicago and it may be reached either by the Chicago and Eastern Illinois Railroad, from the Dearborn St. Station, or by the Chicago and Kankakee, Electrical Line, from the Halsted St. Station.

The Dixie Highway traverses the main section of the village. The topography of the country is fairly level; the geological formation is generally of limestone, but various kinds of sand formation may be encountered at different points. The surface formation is mostly of a hard-used cultivated soil. Goose Creek, which finds its way into Lake Michigan, through Deer Creek and the Calumet River, traverses the northwest corner of the village.

The inhabitants of the village are usually retired farmers and "commuters" from Steger and Chicago Heights. The present population is estimated to be about a thousand. The growth since the last twenty years, has only been about two hundred (as compiled by the Editor of The Crete Citizen.) The inhabitants as a whole are fairly progressive, and what public improvements they have constructed, they were carefully maintained.

From all available information gathered and from the authors' personal observations, there is a good prospect for some growth in the village in the near future.

DESIGN OF SEWER SYSTEM

In designing the sewer system not only were the inhabited sections taken care of, but also those outlying sections which are not as yet subdivided were taken into account in determining the sizes of pipe. The trunk lines are laid out along the centers of the streets, and Y connections provided for each lot on both sides of the street. The minimum size pipe for the main lines is 6 in. Y connections are all of 4 in. pipe.

In computing the quantity of discharge 175 gallons per capita per day was allowed. This is equivalent to .00027 cu.ft. sec. Five persons were allowed to each lot, which has a frontage of 66 ft. The coefficient of rugosity "n" for vitrified salt glazed sanitary sewer pipe is placed by various authors at values from .011 to .015. This difference between .011 and .015

in the friction factor makes often much as 40% difference in the carrying capacity of the sewer. To be on the safe side a mean of the two values was chosen, namely ".013", for which coefficient a chart can be found in Metcalf's & Eddy's Sewerage Practice giving grades, velocity, discharge, and size of pipe. The total discharge amounted to 2.06 cu. ft. per sec.

In determining the size of pipe it was aimed to keep the velocity at about 2 ft. per sec., and also to avoid steep grades, which would necessitate excessive excavation. This was accomplished as shown by the fact that the minimum grade was 0.4% and the maximum grade 1.4%.

Throughout the entire design two drop man-holes were employed.

In recommending means of flushing the sewers, flush tanks were considered ; after looking up the matter the conclusion derived at, was the

fact they are not only costly, but efficient for a distance of only about 100ft., and the constant maintenance and inspection did not warrant their adoption in a problem of this nature. Instead flushing will be accomplished by means of hoses tapped to the fire hydrants and carried to the different manholes.

Lamp holes were also given due weight in the selection for a method of inspection and our opinion cannot be better expressed than that of Metcalf & Eddy in saying that they are a nuisance at best.

Where the system crosses the creek at four different points cast iron pipe will be used. The pipes will be supported by standard hangers fastened by tie rods into small winged wall abutments. In one instant a small trestle of about 150 ft. long will be constructed to carry the cast iron pipe across the creek

at Fifth St. The bents will be made of 4"x4" capped with 2"x4".

As to the width of trenches, it is assumed that a 24 in. width for shallow cuts and 30 in. width deeper cuts is sufficient for a man to work in comfortably.

Manholes will be constructed entirely of concrete, which is more economical in this case, due to the conditions of the soil which requires some form of sheating to facilitate construction. The manhole is made up of two units, a cylinder of concrete 8 in. thick, and a frustum of a cone of 6 in. in thickness, precast and reinforced with 1/2 in. round rods, set directly upon the cylinder.

DESIGN OF SEWAGE SETTLING TANKS

The system as designed is to care for the sewage of a separate system; therefore for house sewage from dwellings, stores and other public buildings.

Since there was no adequate records of the water consumption kept at the village, the authors chose the higher limit of consumption at 175 gallons per capita per day, and for 1000 persons, 175000 gallons per day, which is considered to flow through the tank daily.

The rectangular-horizontal-flow type of Imhoff settling tanks was adopted, because it seemed to suit the local conditions best.

The length of the tank is 50 feet, varying between those adopted at the Emscher District and at Morton Grove (Plant built under supervision of the Sanitary District of Chicago.)

This length with the proper capacity for the detention period of three hours in the opinion of the writers, will give satisfactory results.

Owing to the soft character of the earth and sand foundations at the site of the proposed plant, it was deemed necessary to use a shallower type of tank. Consequently the different parts were proportioned to meet this requirement, but not at the sacrifice of the production of a poorer grade of sludge.

The capacity of the settling basin, estimated on the basis of 175 gallons per capita per day, or .00027 cu. ft. per capita per day, for a three hour detention, is as follows;

$$.00027 \times 1000 \times 3 \times 3600 = 2916 \text{ cu. ft.}$$

In the design 3000 cu. ft. was used. Allowing 15 ft. for the width of the basin, the colloiders,

which have a slope of 1:1 were adjusted to give this capacity.

The sludge digesting chamber is designed for a capacity of 4000 cu. ft. at 5.25 cu. ft. per day per 1000 persons (after Dr. Imhoff) with a detention period of two years. That this length of period has been found practicable it is necessary to refer to the plant at Morton Grove where the sludge has not been removed, except for experimental purposes, since 1914.

The inlet and outlet weirs are set at the same elevation and the channels are adjustable so they can be used alternately as influent and effluent channels. Since the sludge chamber is designed as two compartments, therefore periodical reversion of flow is considered necessary for the equal distribution of sludge in the two compartments.

The bottom of the channel is designed circular,

W

so as to give better means of inspection.

Wooden weirs, fitted in grooves are used to regulate the directions of flow into the different channels and tanks. Oak or other hard wood is recommended.

Cast Iron sludge pipes and bronze mounted valve gates with notched handle are used in the design for the sludge removing end. The sludge is to be removed from its chamber by 10 ft. of head (static pressure) into a sump where the sludge will be pumped out again into a sludge drying bed.

The tank is to be constructed of concrete of a 1:2:4 mix, reinforced with 0.5% of steel rods. The thickness of the walls and colliders are designed for earth pressure as follow.

Data:

Earth pressure @ 100# per sq. in.

$$f_s = 16000$$

$$f_c = 500$$

$$K = 71.3$$

$$N = 15$$

$$p = .005$$

Side walls at different depths.

$$\text{at 17 ft. } d_{17} = \sqrt{\frac{570 \times 13^2}{71.3 \times 12}} = 11.6 \text{ in.}$$

$$D_{17} = d_{17} + 2 = 13.6 \text{ in.}$$

$$\text{at 12 ft. } d_{12} = \sqrt{\frac{400 \times 13^2 \times 12}{71.3 \times 12}} = 9.75 \text{ in.}$$

$$D_{12} = d_{12} + 2 = 11.75 \text{ in.}$$

The authors used 14 in. throughout for the side walls, and reinforced with 3/4 in. round rods at 6 in. centers with 5/8 in. round tie rods at 12 in. centers. The bottom of the tank is thoroughly reinforced with 3/4 in. round rods arranged in layers and the tie rods from the side walls terminating to a point at the apex

of an inverted tetrahydron. With these extra reinforcement a thickness of 12 in. will be sufficient.

The thickness of the side walls and colloiders of the settling basin are set at 6 in. according to recent practice for similar size of tanks, and are to be reinforced with $3/4$ in. round rods at 24 in. centers.

In order to make the tank and channels water proof, a coat of neat Portland cement about a $1/4$ in. thick on the interior surface is specified.

DESIGN SLUDGE DRYING BED

The size of the bed is designed for the ultimate capacity of the two tanks, that is for 2000 persons at 325 sq. ft. for one thousand persons.

The stratifications of the filtering medium is adopted after the design of the Morton Grove plant.

I N D E X T O
P R O F I L E S H E E T S

Sheet #	Name
1-----	Main St.
2-----	Exchange St.
3-----	Columbia St.
4-----	Linden, Fifth & Benton Sts.
5-----	Cass & Division Sts.
6-----	Crete Blvd., Enterprise, Austin & East Aves.
7-----	Herman St. & Hewes Ave.
8-----	Lincoln, Jefferson & First Sts.
9-----	Second & Lumber Sts.
10-----	North & Division Sts. East & Faithorn Aves.
11-----	Elizabeth Ave., & Wood St.

M A P S & D R A W I N G S

Map of Village of Crete

Contour Map of Crete

Layout of Disposal Plant

Sewage Settling Tanks

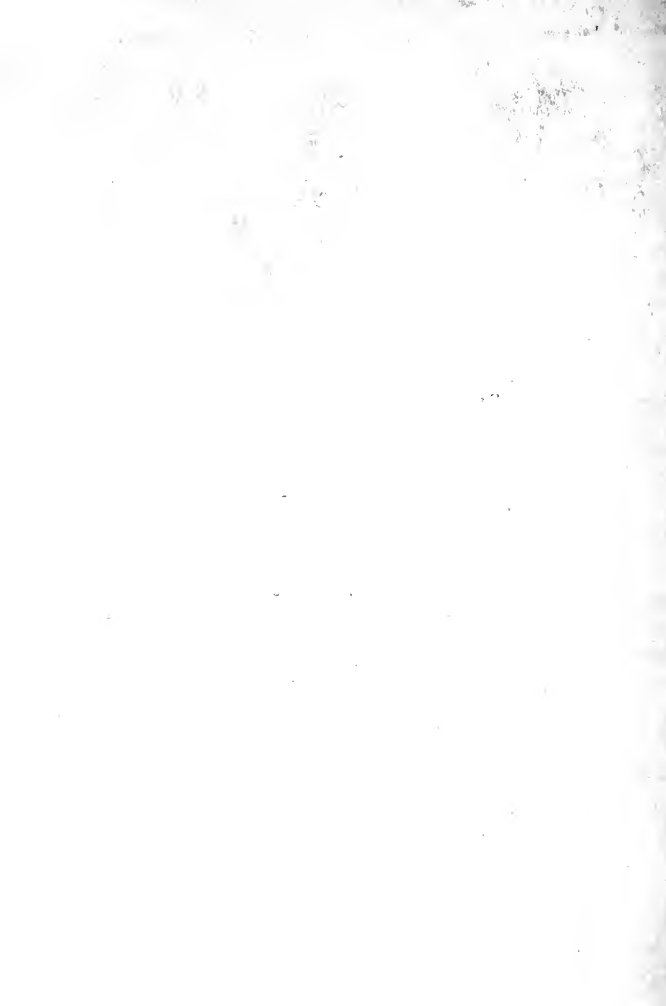
Sludge Drying Bed

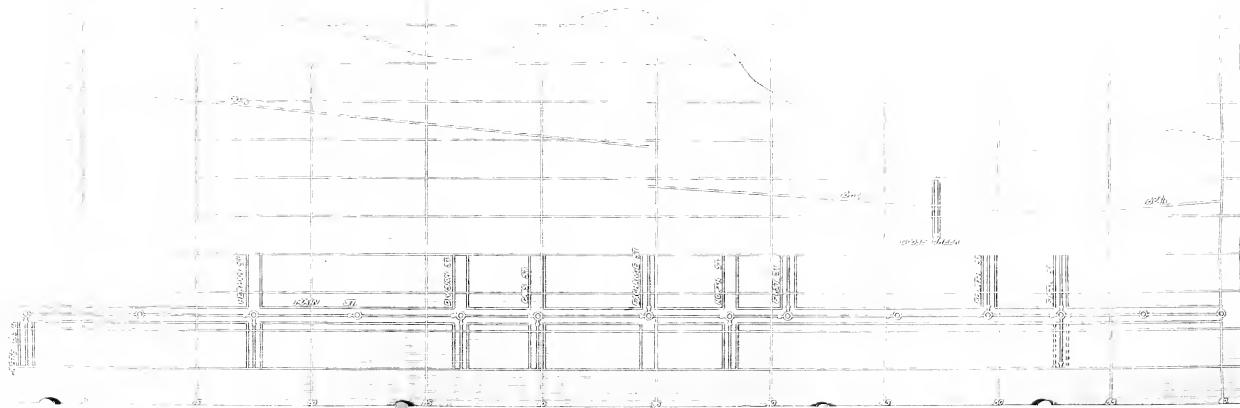
Typical Manholes

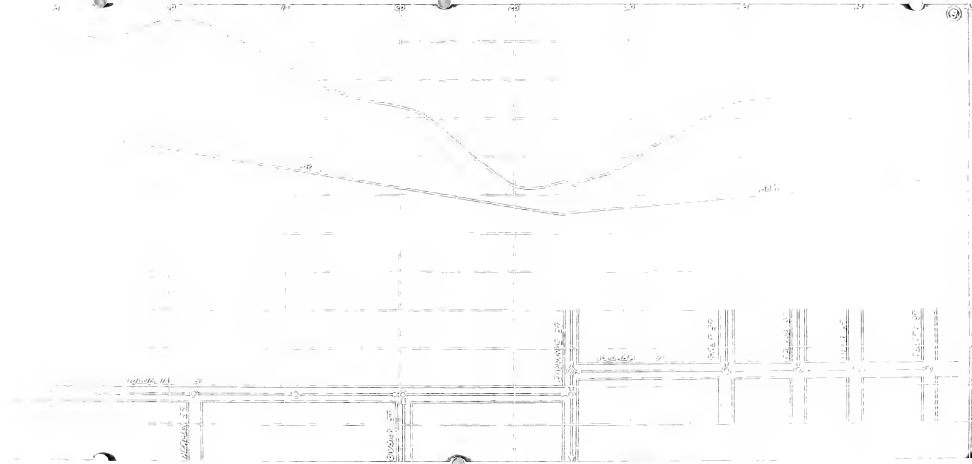












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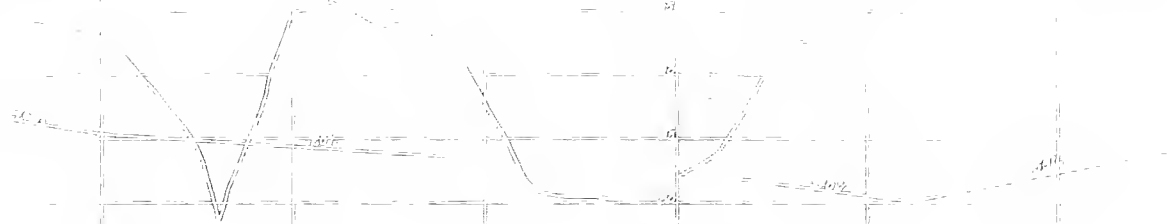
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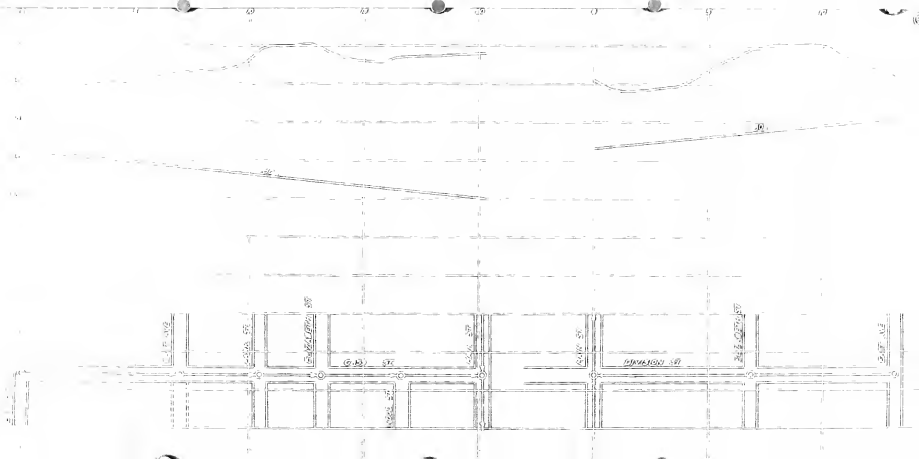
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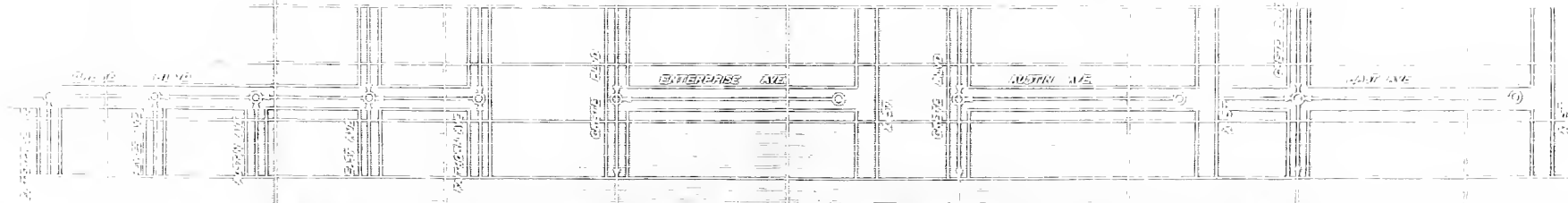
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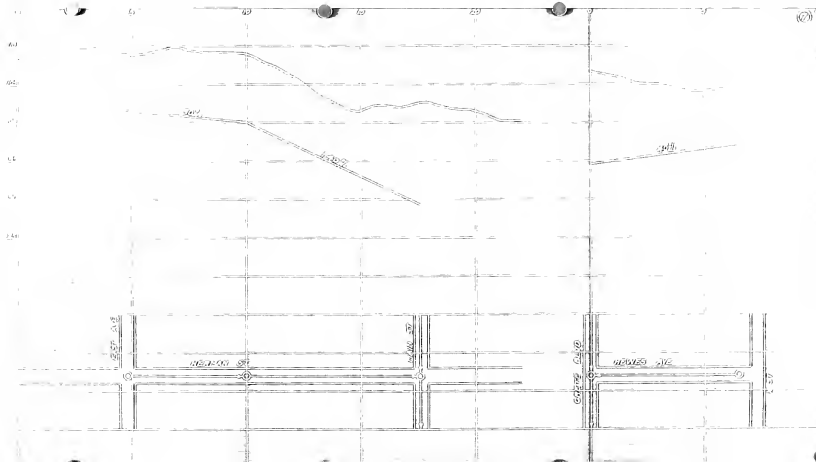
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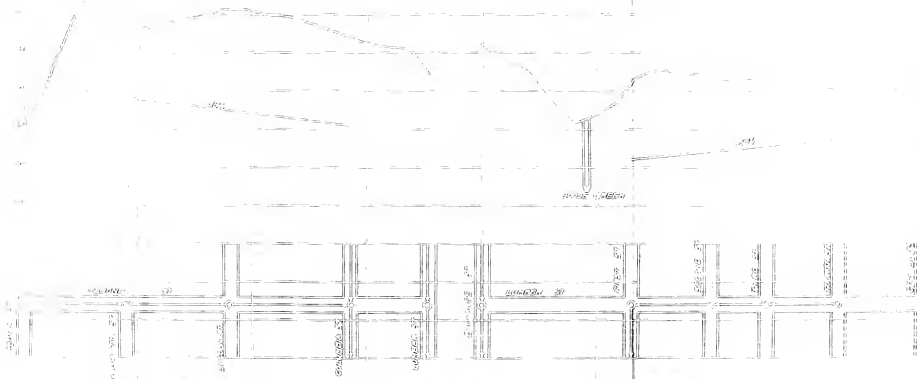






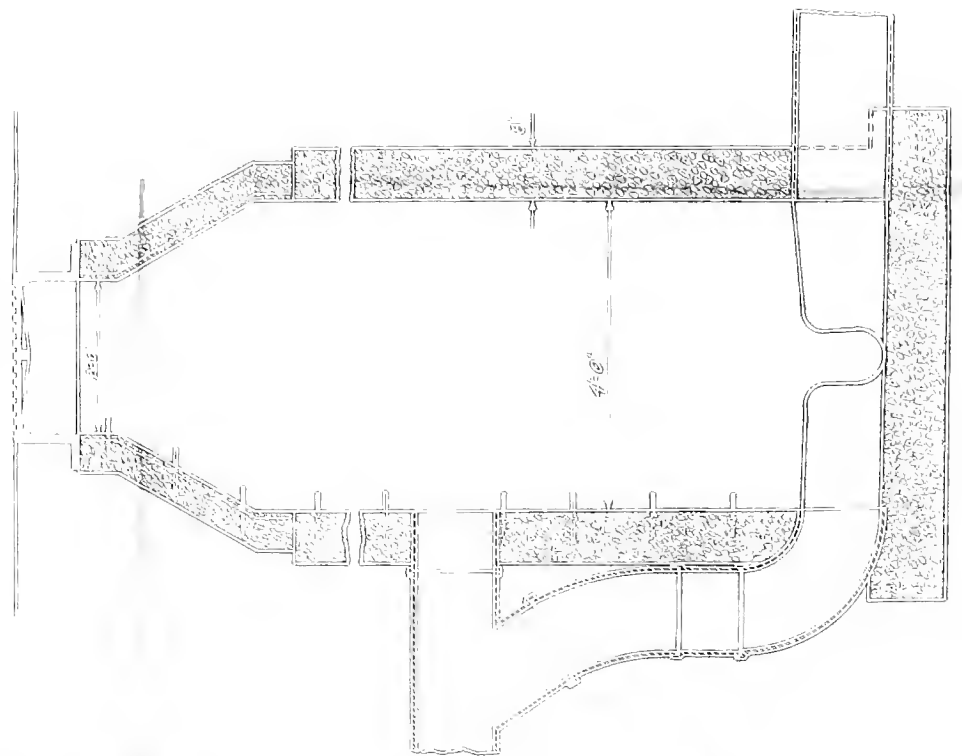
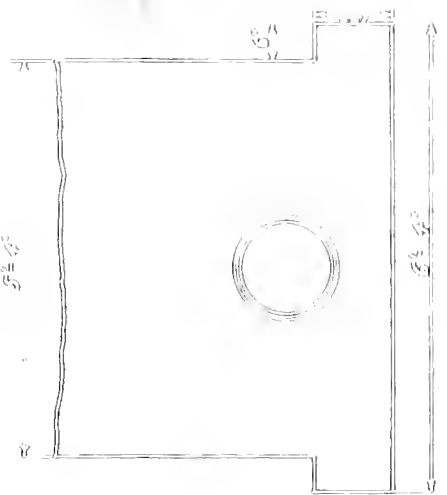
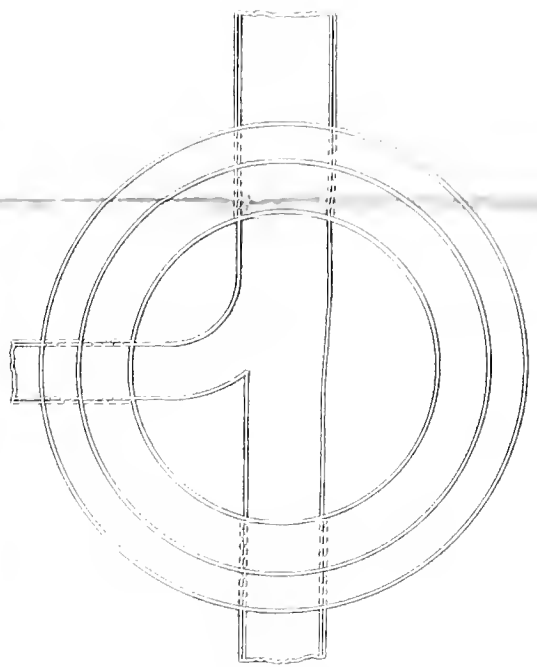




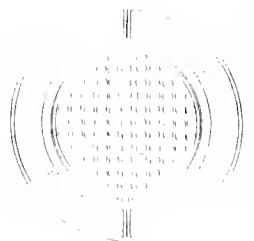




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LAYOUT OF DISPOSAL PLANT

DESIGNED BY GEORGE H. BROWN

RECEIVED BY THE CITY OF BOSTON

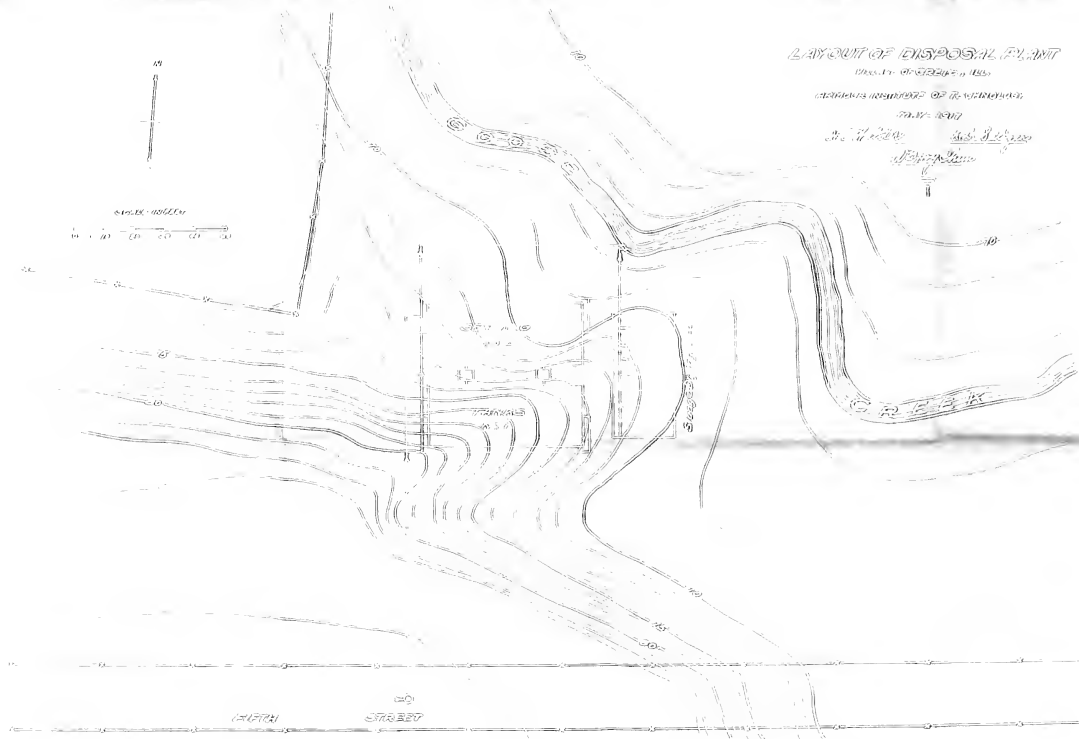
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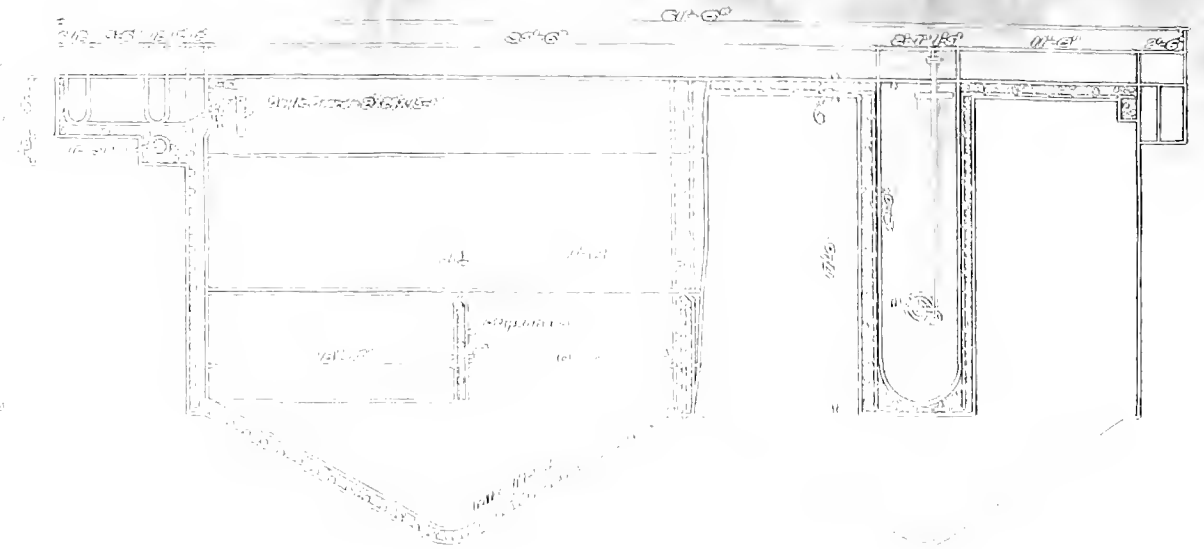
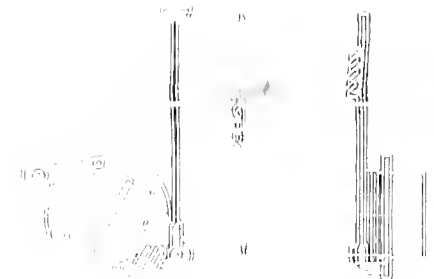
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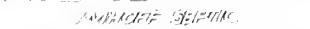
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Scale - 1" = 100' 0"



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1870-1871		1871-1872	
John W. Williams	1870	John W. Williams	1871
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John W. Williams	1872	John W. Williams	1873
John W. Williams	1873	John W. Williams	1874
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John W. Williams	1898	John W. Williams	1899
John W. Williams	1899	John W. Williams	1900



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ANALYSIS AND SYNTHESIS OF THE GUYANOLIDE

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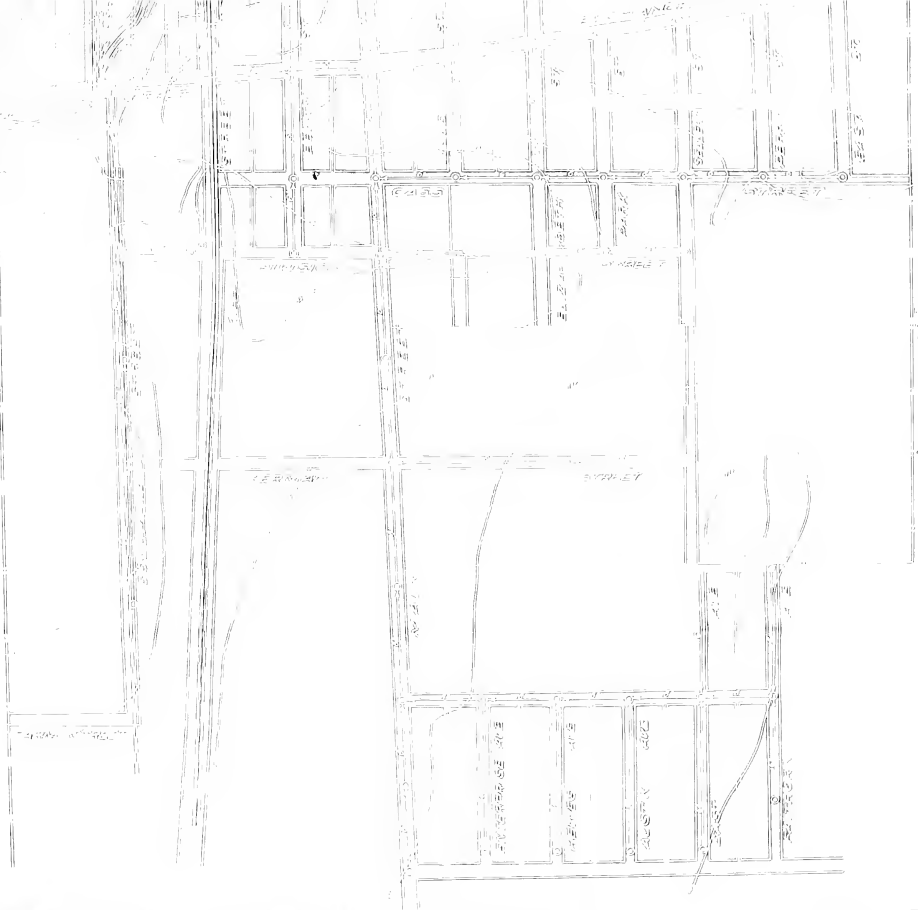
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VILLAGE OF ORIENTE WITH COUNTY MILLIONS



SEWERAGE SYSTEM

Scale of Feet
0 10 20 30 40 50 60 70 80 90 100

